

Internal Bluetooth interface for miniVNA

Version 1.0

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With a very small investment (maybe even less than \$20) and some components which can be easily found at any HAM you can extend the functionality of your miniVNA analyzer by adding some useful features :

- Bluetooth connection to the PC;
- Full cordless operation;
- No external components (all inside the original case).

At the end the miniVNA will look like in the following picture.



The components

First let's see where we can find the main components at the cheap price.

1. **Battery for Canon NB-4L** (~ \$2.5) at:

<http://cgi.ebay.co.uk/ws/eBayISAPI.dll?ViewItem&item=270823876442>



2. **Mini Wireless Bluetooth RF Transceiver Module RS232 TTL 3.3VDC** (~ \$6.5/pcs.) at:

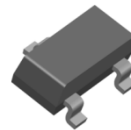
<http://cgi.ebay.co.uk/ws/eBayISAPI.dll?ViewItem&item=200651092652>



3. **MCP73831T-2ACI/OT - LI-ION/LI-POLY CHARGE CONTROLLER** (~ \$0.8) at:
<http://export.farnell.com/microchip/mcp73831t-2aci-ot/li-ion-li-poly-charge-controller/dp/1332158?Ntt=1332158>



4. **TC54VC3002ECB713 - IC, VOLT DETECTOR, 3.0V** (~ \$0.7\$/pcs.) at:
<http://export.farnell.com/microchip/tc54vc3002ecb713/ic-volt-detector-3-0v-sot23a-3/dp/1852224?Ntt=1852224>



5. **IRLML6302PBF MOSFET, P-LOGIC** (~ \$0.7\$/pcs.) at:
<http://export.farnell.com/international-rectifier/irlml6302pbf/mosfet-p-logic-sot-23/dp/9103406?Ntt=9103406>



6. **2N7002 - MOSFET, N, SOT-23** (~ \$0.15/pcs.) at:
<http://export.farnell.com/fairchild-semiconductor/2n7002/mosfet-n-sot-23/dp/9845313>



7. **AMS1117 - LM1117 -3.3V 1117 3.3V 1A Voltage Circuitry Regulator IC** (~ \$0.5/pcs.) at:
http://www.ebay.co.uk/itm/5-pcs-AMS1117-LM1117-1117-3-3V-1117-3-3V-1A-Voltage-Circuitry-Regulator-IC-NEW-/330694806456?pt=UK_BOI_Electrical_Components_Supplies_ET&hash=item4cfef24bb8#ht_2458wt_1037



8. **10uf - 16v Tantalum SMD NRC106K16R** (~ \$0.7) at:

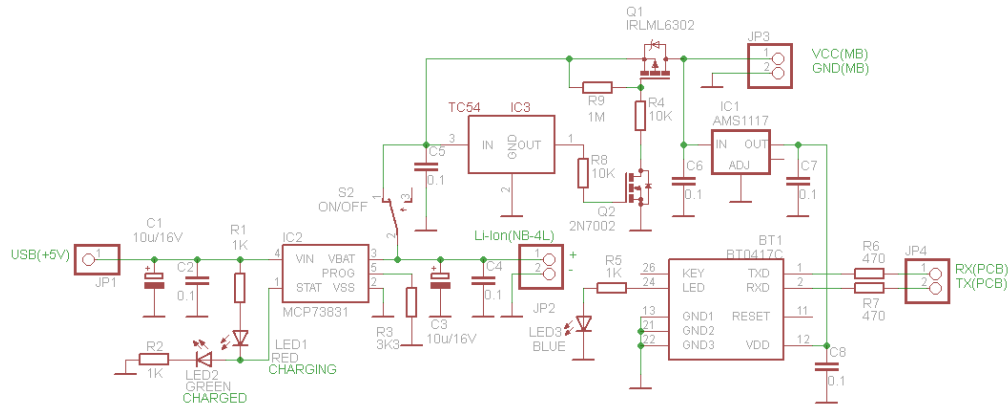
http://www.ebay.co.uk/itm/10uf-16v-Tantalum-SMD-NRC106K16R-Pack-10pcs-/300348384625?pt=UK_BOI_Electrical_Components_Supplies_ET&hash=item45ee28a571#ht_500wt_1054



This is the complete list of parts (BOM):

Part	Value	Device	Package	Obs
BT1	BT0417C	BT0417C	HC-06	
C1	10u/16V	CPOL-EUB/3528-21R	B/3528-21R	
C2	0.1	C-EUC1206	C1206	
C3	10u/16V	CPOL-EUB/3528-21R	B/3528-21R	
C4	0.1	C-EUC1206	C1206	
C5	0.1	C-EUC1206	C1206	
C6	0.1	C-EUC1206	C1206	
C7	0.1	C-EUC1206	C1206	
C8	0.1	C-EUC1206	C1206	
IC1	AMS1117	V_REG_LM1117SOT223	SOT223	
IC2	MCP73831	MCP73831	SOT23-5	
IC3	TC54	TC54	SOT23-3	
LED1	RED	LED3MM	LED3MM	RED
LED2	GREEN	LED3MM	LED3MM	GREEN
LED3	BLUE	LED3MM	LED3MM	BLUE
Q1	IRLML6302	IRLML5203	MICRO3	
Q2	2N7002	2N7002	SOT23	
R1	1K	R-EU_R1206	R1206	
R2	1K	R-EU_R1206	R1206	
R3	3K3	R-EU_R1206	R1206	
R4	10K	R-EU_R1206	R1206	
R5	1K	R-EU_R1206	R1206	
R6	470	R-EU_R1206	R1206	
R7	470	R-EU_R1206	R1206	
R8	10K	R-EU_R1206	R1206	
R9	1M	R-EU_R1206	R1206	
S2	ON/OFF	TL32YO	TL3XYO	mini SPDT switch

The schematic



The schematic is composed from several main blocks:

- the block around MCP73831 is the charging circuit for the Li-Ion cell. The previous USB-B connector is now used only for the +5V power supply from a standard USB port. It provides the right voltage /current and stop the charging when the voltage is at 4.2V. The red LED lights during charging. The green LED lights when the charging cycle is complete (signaling that you can disconnect the miniVNA from the USB port);
- TC54 IC together with Q1 and Q2 protect the Li-Ion cell from deeply discharging (which can destroy the battery or limit the life time). During normal operation OUT pin (1) is at the input level (high). When the cell voltage drops below 3V the output pin (1) goes low. This will completely disconnect the Bluetooth module and the rest of the miniVNA from the battery, preventing further discharging.
- IC1 (AMS1117) is a low dropout 3.3V stabilizer used to power only the Bluetooth module. Other ICs can be used too, but this one was available for me at the time of development.
- The Bluetooth module connects Rx and Tx pins to the serial input of the miniVNA through R6 and R7 to further protect the module from TTL levels available on the miniVNA PCB.

How to build

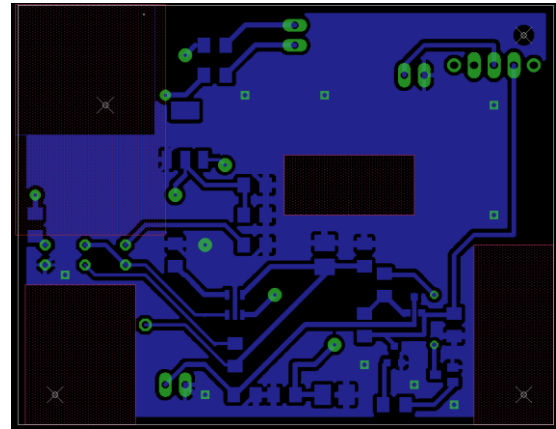
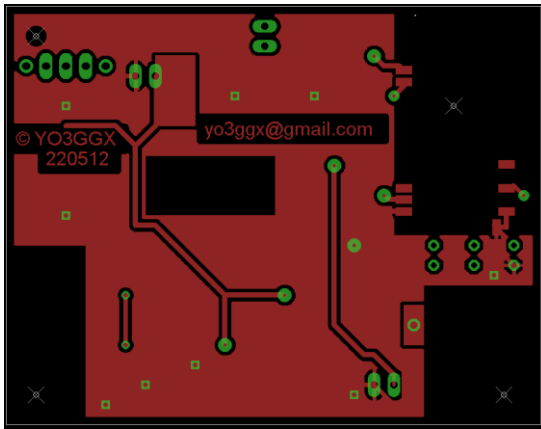
WARNING!!!

Performing this modification will void your warranty. Do not proceed if you are not comfortable with this. Also, all work should be performed by a person who knows how to solder/unsolder using a soldering station that is electrostatic-discharge (ESD) safe. Failure to do so may result in permanent damage to your miniVNA and/or the other used components. This procedure is not particularly difficult, but should not be performed by someone unfamiliar with electronic assembly. I cannot be held responsible for any damage caused to your miniVNA.

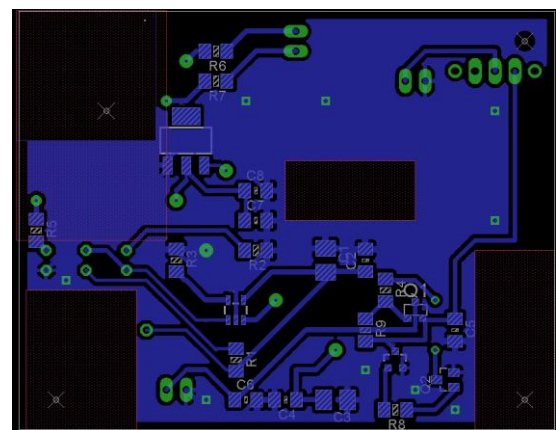
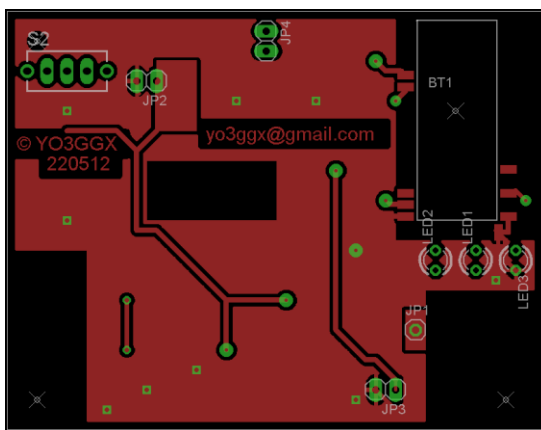
All the steps will be presented in several intuitive pictures.

1. Build the new module

Both sides of the PCB are presented in the following pictures (bottom side is mirrored).



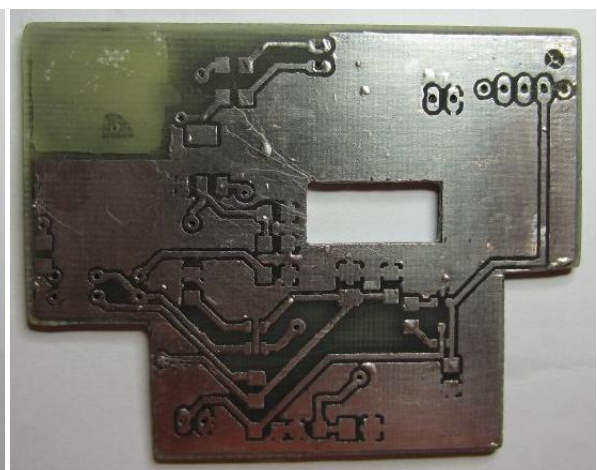
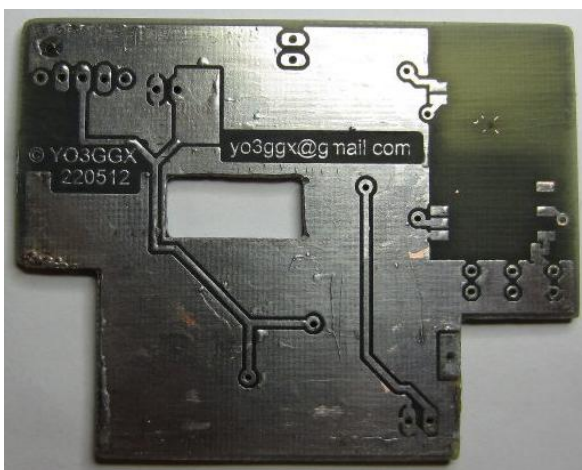
All the SMD components are placed on the bottom side (blue one, mirrored).
Next you can see the components placement on both sides.



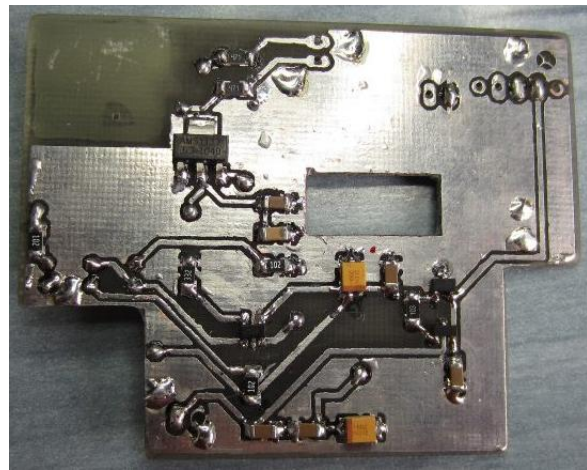
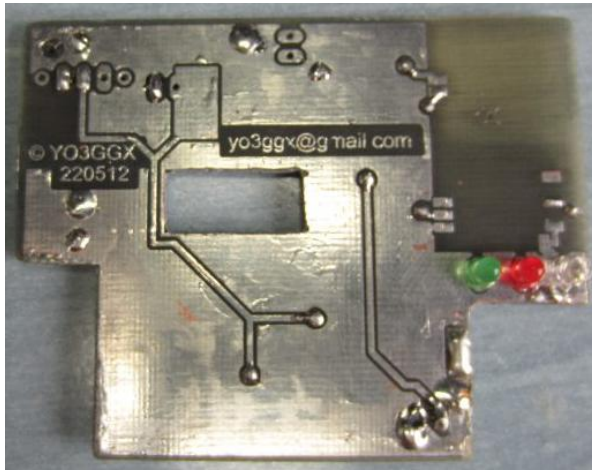
You can use the proffered method to make the PCB. I've used the toner transfer method, using a laser printer, glossy photo paper and a GBC Docuseal 40 mini laminator.

This is how my tinned PCB looks like (both sides, without components).

NOTE: The real pictures are from a previous version, which was slightly modified because of a small error in the schematic.



This is the PCB after all the SMD components were placed on the bottom side and the LEDs on top side.



All the vias are manually connected on both sides using small pieces of wire.

Now fix the Li-Ion cell on the top of the PCB using a few pieces of double sided adhesive tape. Solder the + and – pins of the battery directly on the PCB using again small pieces of wire. Take care when fixing the battery not to be too close to the PCB edge, in order for the miniVNA case cover to have enough space to enter.

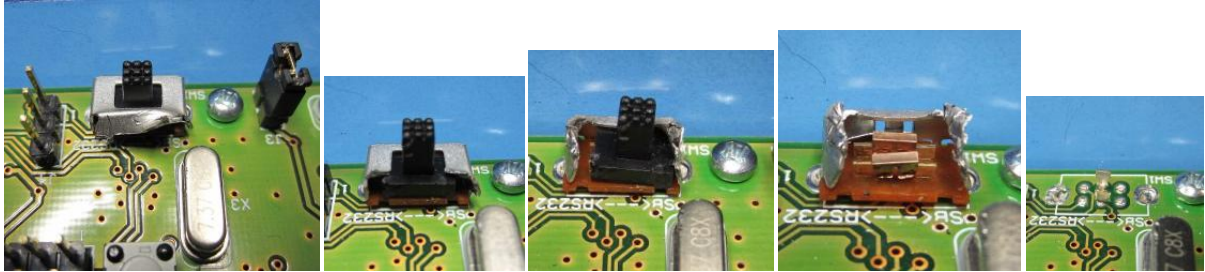
Solder the Bluetooth module, the power switch and the pin headers on the top side of the PCB. The module must look like in the following picture:



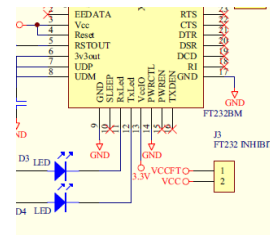
2. Prepare the miniVNA to accommodate the new module.

Usually the standard miniVNA can be used through USB or an RS232 interface, through an internal TTL-RS232 converter. The two modes are selectable through SW1 (see picture). In order not to use another level converter from Bluetooth module (3.3V) to RS232(+/- 12V) which will increase the device consumption and will increase the add-on complexity, I decided to disable the internal level converter (MAX3221) and to connect directly to the CPU serial pins. The direct serial pins (PD0 and PD1) are available at the SW1 level (see following picture).

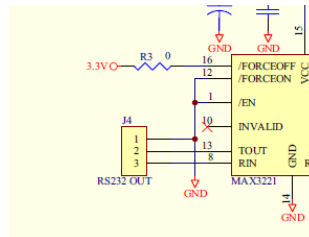
Not to dismount the main miniVNA PCB, I have used another approach. SW1 was dismounted using a mechanical way, not by unsoldering it (which is not possible from the top of the PCB). See the steps in the following pictures.



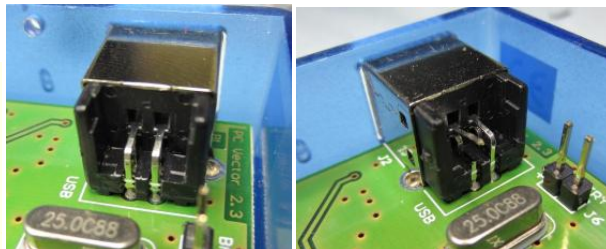
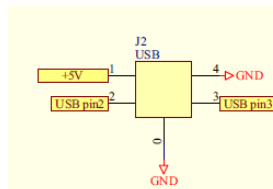
Remove jumper J3 (to remove the power from the USB/serial converter) and cut the pins.



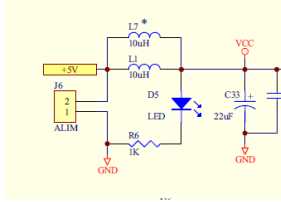
Completely cut the pins on J1 (RS232 port) as this is no more used.



Cut the +5V pin from the USB connector. This will be further connected to our new module and used only for charging purpose.



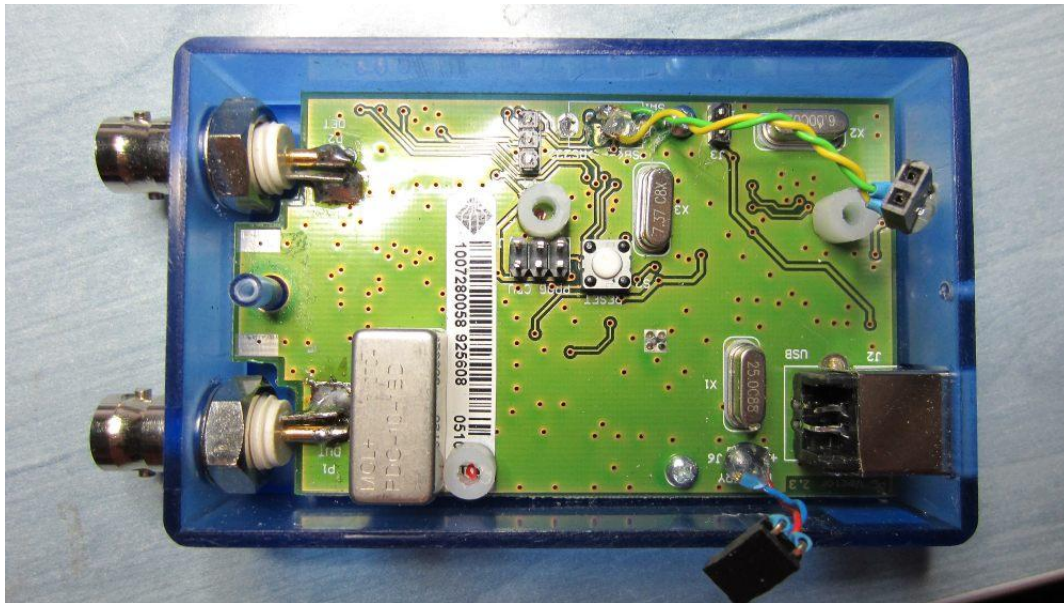
Shorten the pins on J6 to around 3mm. This will be used to further power the main miniVNA circuit from our module.



Through some pieces of multifilar isolated wires Solder one 3 pin female header (made from IC socket pins) to PD0, PD1 (from former SW1 central pins) and GND and one 2 pins to former J6.

Shorten WITH around 2mm the pins from the PROG connector in order to make enough space for the Li-Ion cell. Using superglue fix 3 (5mm) spacers in the specified places.

At the end the “mutilated” miniVNA PCB will look like in the following picture.



3. Install the module in the miniVNA case

Make a hole in the case for the new power switch button.

No you just need to insert the new module in the minivan case. The three spacers will support the new PCB and the case cover fill firmly fix it when mounted.

See the following document to see how to program the Bluetooth module. You need to configure the baudrate (115200), the name of the device (minivna) and optional the pairing PIN (default is 1234).

For this purpose follow the procedure specified in the following document.

http://www.yo3ggx.ro/FT8x7_DIY_Bluetooth_CAT_interface_v1.pdf in the chapter named “Programming the interface”. You can directly use the small cable which comes with the USB-serial module for programming purpose. When you’re ready, insert the 2 header connectors and solder the +5V pin from the USB-B connector to the respective pad on the PCB.



You are now done. Just insert the cover and fix it with the two screws.

4. Configure the software

Follow the procedure in the same document

(http://www.yo3ggx.ro/FT8x7_DIY_Bluetooth_CAT_interface_v1.pdf) to pair the minivna with the PC where the software is installed.

5. Operating the analyzer - measurement example

This is a small video tutorial to better understand how to operate the newly modified analyzer.



Bibliography

AMS1117 datasheet: http://www.datasheetcatalog.com/datasheets_pdf/A/M/S/1/AMS1117.shtml

TC54 datasheet: <http://ww1.microchip.com/downloads/en/DeviceDoc/21434h.pdf>

IRLML6302PBF datasheet: <http://www.irf.com/product-info/datasheets/data/irlml6302pbf.pdf>

MCP73831 datasheet: <http://ww1.microchip.com/downloads/en/DeviceDoc/21984c.pdf>

miniVNA schematic:

http://groups.yahoo.com/group/analyzer_iw3hev/files/Product%20%203E%3E%3E%3E%20miniVNA/

Document History

Initial version of the document (v1.0).

miniVNA_BT_akk_v1.0.pdf - Bucharest, May28th 2012 – © Dan Toma – YO3GGX – yo3ggx@gmail.com